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OUTLOOK ARTICLE

How to avoid history repeating itself: the case for an EU Emissions Trading System (EU ETS) price floor revisited

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ABSTRACT

Several years of very low allowance prices in the EU emissions trading scheme (ETS) have motivated calls to introduce a price floor to correct potential underlying distortions and design flaws, including (i) the political nature of allowance supply and related credibility issues, (ii) potential myopia of market participants and firms, and (iii) waterbed and rebound effects resulting from policy interactions. In the wake of the recent EU ETS reform, allowance prices have sharply increased. This raises the question of whether the case for introducing a price floor in the EU ETS remains valid. We argue that such a price floor, also adopted in several other greenhouse gas cap-and-trade systems worldwide, remains an important improvement in the design of the system, as long as the above-mentioned distortions and design flaws persist. An EU ETS price floor can safeguard against these issues and provides more explicit guidance on the minimum allowance price policymakers consider acceptable. Either as a complement or substitute to the current Market Stability Reserve (MSR), a price floor would thus make the EU ETS less prone to future revision in case of unexpectedly low prices. We identify and confront four prominent arguments against the introduction of an EU ETS price floor.

Key policy insights

- An EU ETS price floor would be an important institutional innovation enhancing political and economic stability, and predictability of the EUA price
- The recent Market Stability Reserve (MSR) reform has not removed the need for a carbon price floor.
- Introducing an element of price responsiveness into the so far purely quantitative design of the EU ETS would help to preserve its integrity
- In contrast to conventional wisdom, legal analysis reveals that an EU ETS price floor can be legally feasible
- Political support for a carbon price floor is gaining traction across Europe

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1. Introduction

The EU Emissions Trading Scheme (ETS) has for many years delivered prices below initial expectations. If low prices merely indicate low mitigation costs, they illustrate that the scheme works as theory suggests (Ellerman, Marcantonini, & Zaklan, 2016). However, the concern has been raised that low prices reflect market distortions and design flaws (Edenhofer, Flachsland, & Schmid, 2019). These distortions include (i) the political nature of allowance supply and related credibility issues, (ii) myopia or inefficient discounting of market participants and firms, and (iii) waterbed and rebound effects, that is, unilateral emission reductions that are either ineffective

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as cumulative EU-wide emissions remain unchanged, or that even lead to an increase in cumulative emissions. Also, allowance prices in cap-and-trade are subject to large uncertainty (Borenstein, Bushnell, Wolak, & Zaragoza-Watkins, 2018) and market distortions may lead to inefficiency if opportunities for hedging through risk markets is limited (Tietjen, Lessmann, & Pahle, 2019). The potential presence of these issues risks negative long-term consequences by failing to initiate and support the technological and economic transformations necessary to decarbonize the economy (Acworth et al., 2017; Fuss et al., 2018).

To address these concerns, adding a carbon price floor to the EU ETS has been proposed, following the examples of the Regional Greenhouse Gas Initiative (RGGI), the common ETS of California and Quebec, and some Chinese pilot ETS (Boehringer & Fischer, 2018; ICAP, 2019; Knopf et al., 2014). However, the sharp increase of European Emission Allowances (EUA) prices in 2018 to levels around 25–30€/t (September 2019) places the EUA price at the magnitude found in economic optimization models employing a cost-effectiveness approach that takes the EU ETS cap as given (Pahle, Burtraw, Tietjen, Flachsland, & Edenhofer, 2018). The recent EU ETS reform has increased the Linear Reduction Factor determining the annual rate of decline of the cap, and has modified the Market Stability Reserve (MSR) to increase the rate of annual allowance removals and invalidate (cancel) allowances. While it remains challenging to empirically assess the optimal level of allowance prices in cap-and-trade systems (Hintermann, Peterson, & Rickels, 2016), the reform seems to have successfully addressed the broader concern over low prices. This raises the question of whether the case for a price floor in the EU ETS remains valid, which ultimately depends on the problem diagnosis.

We argue that a price floor remains an important improvement in the design of the EU ETS if there is uncertainty over the existence of the above-mentioned distortions and regulatory failures that might prevent dynamically efficient price formation. The potential existence of these issues implies the risk of a dynamically inefficient EUA price path (e.g. Fuss et al., 2018; Salant, 2016). A price floor can reduce this risk, and provides more explicit guidance on the minimum EUA price policymakers consider acceptable. Either as complement or substitute to the current MSR design, a price floor would thus make the EU ETS less prone to requiring future revision in case of unexpectedly low prices.

Our contribution draws on two methods. First, we conducted a comprehensive review of the academic and policy literature on greenhouse gas (GHG) cap-and-trade system price floors and their adoption in existing systems worldwide, and on the recent EU ETS reform. Second, from 2016 to 2019, the authors organized and participated in several workshops in which academic analyses and policy questions relating to the introduction of a price floor were explicitly discussed with high-level stakeholders from academia, policy (EU and national institutions), industry, and NGOs. Building on these workshops, additional conversations with key policymakers and stakeholders, and close monitoring of the policy debate since inception of the EU ETS in 2005, as well as extensive discussions within the author team, we distilled a set of four objections to a price floor, which we set out and respond to below.

2. The recent EU ETS reform: mainstream diagnosis and therapy

Different reasons for low EUA prices from 2012 to 2018 have been suggested, not least because understanding of the drivers of EUA prices remains poor (Friedrich, Mauer, Pahle, & Tietjen, 2019; Hintermann et al., 2016). The mainstream view has been that the key reason for prices being lower than expected is an 'imbalance' of allowance supply and demand. This is thought to result from the economic crisis in 2009, the influx of credits under the Clean Development Mechanism, and additional renewable and energy efficiency policies at the EU and member state levels that are considered to have driven emission reductions (Ellerman et al., 2016; Fuss et al., 2018; Koch, Fuss, Grosjean, & Edenhofer, 2014). In this line of reasoning, allowance demand turned out to be lower than expected, leading to lower prices compared to *ex ante* expectations. This view has been guiding the recent EU ETS reform that intended to 'reduce the surplus of emissions allowances […] and to improve the EU ETS's resilience to shocks' (EC, 2019).

In consequence, the EU ETS reform adopted in 2018 primarily aimed at creating additional scarcity in the market. This is to be achieved, first, by strengthening the linear reduction factor, which specifies the amount that the cap will be reduced annually, from 1.74 to 2.2%. Second, the rate at which the MSR diverts allowances

from auctions when the stock of allowances in circulation exceeds 833 million EUAs was doubled from 12% to 24% for the period 2019 until 2023. Third, all allowances in the MSR exceeding the level of the previous year's volume of auctioned allowances will be invalidated from 2023 on. Fourth, unilateral invalidation of allowances by member states in proportion to national regulations closing down facilities, e.g. coal plants, covered by the EU ETS is now allowed.

The reform will reduce allowance supply, thus addressing concerns about supply-demand imbalances. Estimates regarding the amount of allowances moved to the MSR and invalidation of allowances vary significantly (Beck & Kruse-Andersen, 2018; Bocklet, Hintermayer, Schmidt, & Wildgrube, 2019; Bruninx, Ovaere, & Delarue, 2018; Carlén, Dahlqvist, Mandell, & Marklund, 2019; Danish Council on Climate Change, 2017; Perino, 2018; Perino & Willner, 2017; Quemin & Trotignon, 2019; Sandbag, 2017; Silbye & Sørensen, 2018; Tietjen et al., 2019). For example, Quemin and Trotignon (2019) find that up to 10 Gt will be invalidated, in contrast to 1.7 Gt in Perino and Willner (2017).

During the reform debate and especially after the reform was decided, the EUA price rose discernibly. According to standard economic theory, the most likely explanation is that anticipated future scarcity of allowances – reducing supply – resulted in increased current prices (Perino & Willner, 2017). Other work suggests that transferring allowances into the MSR has created transitional stringency sufficient to raise prices at least in the short-term (Mauer, Okullo, & Pahle, 2019; Perino & Willner, 2016), especially if the hedging demand of firms for allowances is considered (Tietjen et al., 2019). A complementary interpretation is that the reform has restored market confidence in the willingness of EU policymakers to invest political capital into sustaining the ETS, triggering the comeback of allowance traders taking longer-term positions in the market (Sheppard, 2018; Tagesspiegel, 2018). Another interpretation is that price formation is myopically driven by short-term demand and supply, e.g. if firms have truncated planning horizons (Quemin & Trotignon, 2019), and that the increased intake rates of the MSR has led to a tighter short-term market, inducing an EUA price increase.

It is uncertain, though, whether the fundamental problems of the EU ETS have been resolved for good. First, there is no solid evidence for what has driven the recent price increase. It might well be a bubble in an overconfident market (Friedrich & Pahle, 2019). Second, there is a persistent risk that market confidence may be undermined again by future economic or political shocks. Given the complexity of the MSR, market actors may misjudge future effects, and unexpected outcomes may require further market interventions, possibly affecting market confidence. In fact, Phase IV of the EU ETS envisions a formal MSR review process in 2021, and one outcome of that process may be further changes to the MSR's operation, including the intervention and invalidation parameters. Finally, the waterbed has not been effectively removed by the recent reform (see Section 4.1) and might lead to lowered allowance prices. Overall, we cannot rule out that history will repeat itself and EUA prices will drop substantially again – with potentially significant consequences for the legitimacy and political support of the policy instrument. We next argue that a price floor can help to at least partly remove related problems.

3. The case for an EU ETS price floor and implementation options

In contrast to the mainstream diagnosis of low EUA prices in recent years, another strand of literature suggests, from a theoretical perspective, that key factors depressing allowance prices were anticipated future downward price shocks or persistent doubt about the level of ambition (Salant, 2016). Complementing this theoretical analysis, evidence suggests that past regulatory events, such as the backloading reform episode,[1] have indeed negatively affected market credibility and were likely decisive factors in triggering the EUA price decrease (Koch, Grosjean, Fuss, & Edenhofer, 2016). Inefficient discounting, for example due to myopia, regulatory risk, or incomplete risk markets, might also dampen near-term allowance prices (Kollenberg & Taschini, 2019; Quemin & Trotignon, 2019; Tietjen et al., 2019). In addition, reduced market confidence and low prices arguably reinforce unilateral member states' efforts to introduce additional policies to attain national climate targets, which may further drive down prices in a negative spiral due to the waterbed effect (Pahle, Burtraw, Tietjen, et al., 2018). If these were indeed the underlying problems – rather than, or in addition to, those suggested by the mainstream analysis – the recent reform then may at best just have cured the symptoms, but not their cause.

It is important to note that the mainstream diagnosis of the allowance price being lower than expected because of allowance demand turning out to be lower would not necessarily motivate intervention in the market: In absence of market or regulatory distortions, the market would simply work as it should. Lower than expected costs of meeting the cap might politically facilitate tightening of the cap to realize more environmental gains, but would not be mandated from a cost-effectiveness perspective. By contrast, any intervention aiming at supporting the EUA price without aiming at increasing the level of environmental ambition would start from the premise that some market or regulatory distortion prevents the price from achieving its cost-effective pathway. This is exactly the rationale underlying the case for a carbon price floor.

The main benefit of a price floor is that it would enhance long-term investment certainty by providing a clearer signal of regulators' commitment to achieve ambitious decarbonization targets even in the case of market and policy distortions driving the allowance price below its cost-effective pathway (Burtraw, Palmer, & Kahn, 2010). Such reduced uncertainty would facilitate dynamically cost-effective allocation of investments into low-carbon technologies. This would also contribute to avoiding a situation where a lack of low-carbon investments in earlier years due to inefficiently low EUA prices might lead to significantly rising abatement costs and allowance prices in later years ('hockey stick'). Such an outcome would potentially undermine the political acceptability and environmental integrity of the cap that, as a result, might even be relaxed to avoid such high costs (Edenhofer, Flachsland, & Schmid, 2019). To illustrate the relationship between downward price uncertainty and investment, when adding a price floor, firms facing investment decisions under uncertainty will, at the margin, implement 'green' investment projects that would otherwise (i.e. without a price floor) not be profitable in face of unmitigated downward EUA price risk. Conversely, firms will refrain from 'brown' high-carbon investments that are profitable only when factoring in downward EUA risk. Note that to achieve the objective of reduced uncertainty, the price floor pathway may be chosen slightly below what is anticipated to be the cost-effective trajectory – the aim is not to implement a binding price floor.

In addition, a price floor can also help avoid myopic price formation e.g. if it becomes binding and thus aligns the carbon price trajectory more closely with the dynamically efficient level and rate of increase (Fuss et al., 2018). Finally, the price floor can also reduce the waterbed effect from unilateral policies or any type of voluntary emission reductions when it turns out to be binding and is designed to induce removal of allowances from the market. This can help sustain the political acceptance of the scheme (Pahle, Burtraw, Tietjen, et al., 2018).

While it is correct that a price floor may be politically revised (downwards or upwards), and thus does not offer a perfect commitment device, we argue that policy stability and credibility is at least gradually increased, thus improving investment incentives. This important benefit comes at no cost in terms of reduced system performance. The price floor would only induce social costs if it would prevent the allowance price from dropping to an efficiently low level, e.g. in the case of significant low-carbon technology cost reductions. However, governance provisions should enable a structured review process of the price floor in any case, to enable adjustments if good reasons do emerge (note that the price floor pathway might also be adjusted upwards). Perhaps more importantly, the main cost appears to be political capital expended to initiate and implement the floor price reform in the first place.

A price floor can be implemented in the following ways: The ETS of California and Quebec, and several Chinese provincial ETS pilots, have implemented a price floor as an auction reserve price(s) below which none or only a fraction of allowances will be sold (ICAP, 2019). RGGI also implements its price floor in its auction, and adds a price step known as the Emissions Containment Reserve, which provides a minimum price above the price floor that applies to 10% of the emissions cap, creating a price-responsive allowance supply (Burtraw et al. 2018). In the EU ETS, an EU-wide auction reserve price might be introduced in addition to the quantity threshold level of 833 megaton (Mt) allowances in circulation in the MSR. Unsold allowances could be moved into the MSR, where they might eventually be invalidated.

A second potential price floor implementation option is the UK carbon price floor (CPF), which requires power sector facilities covered by the EU ETS to pay a carbon price support that scales negatively with expected EUA prices to ensure that a specific domestic minimum carbon price is always achieved (Hirst, 2018; Newbery, Reiner, & Ritz, 2019). Currently, the support is set at £18/t (~€20) until 2021, adding to an EUA price of about €20–€25/t. To make the support rate more responsive to the actual EUA price realization than in the UK design, an ex post

adjustment based on the realized EUA price is an alternative implementation option (Wood & Jotzo, 2011). To avoid the waterbed effect resulting from the CPF, a proportional amount of allowances would need to be withheld from the market.

4. Debating the price floor option

In discussions with various stakeholders (see Introduction), we identified four prominent arguments against the introduction of an EU ETS price floor, which we confront below.

4.1. Objection 1: the MSR reform removes the need for a price floor

Objection: The recent price increase demonstrates that the fundamental problems of the EU ETS have been addressed. The allowance removal and invalidation features of the MSR reform eliminate the waterbed effect and reestablish fundamental allowance scarcity. The policy environment for low-carbon investments is now stable and predictable.

Response: The causality and durability of the recent EUA price increase is not yet determined. We cannot know whether the reform and economic circumstances will sustain high price levels**.** There is significant divergence in assessments of the impacts of the MSR, and market participants might misconceive the actual impact of the complex MSR invalidation mechanism. Credibility issues might easily return in case of political and economic shocks. Moreover, Perino and Willner (2016) and Kollenberg and Taschini (2019) find that the MSR (without cancellation) increases price variability, which raises the question of whether it stabilizes the market environment. A carbon price floor would more effectively constrain the downward uncertainty over future EUA prices and thus facilitate the required low-carbon investments.

The reform has at best partially addressed the waterbed effect of unilateral policies, but not eliminated it. A mechanism that perfectly accounts for unilateral policies would reduce the ETS cap by the emission abatement achieved by those policies. The amount of MSR cancellations, however, depends on the time profile and rebound effects of the emission reductions induced by unilateral policies. Several studies show that the MSR cancels less allowances in later years of its operation. Thus, the further in the future emission reductions from unilateral policies occur, the higher the waterbed effect (e.g. Beck & Kruse-Andersen, 2018; Perino, 2018). The reason is that the MSR absorption of allowances from the bank – the aggregate of all unused allowances held by market participants – will decline over time. In the early years of MSR operation, there will be an influx of allowances into the MSR because the allowance bank exceeds the threshold level of 833 Mt. At this time additional emission reductions increase the bank and thus the influx into the MSR. Over time, however, the MSR reduces the bank until it is lower than threshold of 833 Mt. Once the bank is low enough, unilateral policies may increase the bank but do not necessarily increase the influx into the MSR.

Moreover, Rosendahl (2019) and Pahle et al. (2019) find that unilateral policies can even lead to less MSR cancellations, implying that policies that aim to reduce emissions paradoxically increase cumulative emissions in the EU ETS. This can happen if a policy is announced today but effective in the future. Pahle et al. (2019) consider the German coal phase-out which was announced in 2019 but whose impacts would mostly unfold only from 2030 onwards. Given that market participants today anticipate lower allowance demand in the future due to the phase-out, the allowance price already drops today because of intertemporal arbitrage. This allowance price drop implies that more allowances are used early on and thus the number of allowances in the bank is lower since the coal phase-out has only minor effects at this time. In consequence, there is less short-term influx into the MSR as well, implying fewer allowances being cancelled. When the coal phase-out becomes most effective (after 2030) the decreased allowance demand has only minor effect on the influx into the MSR (see above). In the aggregate, the coal phase-out may therefore actually increase cumulative emissions in the EU ETS. In addition, policies with an immediate effect on emissions may also lead to less cancellation because of rebound or 'internal carbon leakage' effects (Perino, Ritz, & van Benthem, 2019). This may occur if emission reductions in one country are overcompensated by expansion of emissions in other countries due to rising carbon-intensive exports (this is relevant e.g. in electricity markets, Osorio, Pietzcker, Pahle, & Edenhofer, 2018).

4.2. Objection 2: a price floor would transform the EU ETS from a quantitative policy instrument into a pricing instrument

Objection: Much effort has been invested in establishing the ETS as a quantitative policy instrument. This regulatory approach has ensured broad support from member states, industry, and EU institutions because it promises to achieve the climate target.

Response: A pure quantity target is not necessarily optimal; rather it is the consequence of a scientifically informed regulatory negotiation. If emissions reductions turn out to be less expensive than anticipated, then regulators would be expected to compel greater emissions reductions, and the price floor would embody such instruction to the market (Wood & Jotzo, 2011). Price floors have been widely adopted in quantity-based ETSs worldwide, and for good reason (ICAP, 2019). In fact, the EU ETS is increasingly becoming a special case in not featuring quantity adjustment based on rule-based price triggers. Furthermore, introducing a price floor does not imply the instrument is not based on quantity controls; if unsold allowances are invalidated, a price floor would achieve *more* ambitious environmental targets than those envisioned by the baseline cap and at prices that are below anticipated costs.[2] From economic theory, a hybrid instrument that combines elements of quantity and price regulation is likely to be superior to either approach taken alone for regulating carbon emissions under uncertainty (e.g. Hepburn, 2006; Newell & Pizer, 2003; Roberts & Spence, 1976; Weitzman, 1974; Wood & Jotzo, 2011).

4.3. Objection 3: a carbon price floor is not legally feasible

Objection: A carbon tax could not be introduced in the 1990s because of the EU Council unanimity requirement of EU treaties on tax matters. This legal requirement would also make an EU ETS price floor infeasible.

Response: Fischer et al. (2018) reject the claim that introducing an auction reserve price into the EU ETS could not proceed with the ordinary legislative procedure. To trigger the special (unanimous voting) rather than ordinary (qualified majority voting) legislative procedure, a reserve price would have to be 'primarily of a fiscal nature' or 'significantly affect a Member State's choice between different energy sources.' The first trigger ('primarily of a fiscal nature'), although not well defined in EU law, should not apply for three reasons: First, the primary aim of the EU ETS is to reduce emissions, not to raise government revenue. Much of the allowance revenue is either freely allocated (negating the revenue motive) or earmarked for mitigation programmes (as with a fee), but not collected for general revenue (as with a tax) (Löfgren, Burtraw, Wråke, & Malinovskaya, 2018). Furthermore, an auction reserve price may lower or raise revenues, since the prices may rise but the number of allowances sold falls. Second, EU allowances have the status of financial instruments, and the ETS thus has already been shown not to be of fiscal nature. Third, an auction reserve price would not change the character or strictly fix the EUA price. Allowances could trade above or below that level in the secondary market, as has been the case in the California system.

Fischer et al. (2018) also reject the argument that an ETS auction reserve price might 'significantly affect a Member State's choice between different energy sources.' First, an allowance price does not directly determine the energy mix of member states. Instead, its effects depend on the broader market situation (e.g. fuel prices). A legal trigger for the treaty unanimity requirement should not depend on market circumstances. Second, the EU ETS embodies an important environmental goal in justifying the competence of the European Union to introduce a cap-and-trade system establishing an EU-wide carbon price, and an incremental reform supporting the system would rely on the same competence. The European Court of Justice rejected a recent challenge by Poland to the initial version of the MSR based on this legal trigger, finding that market circumstances remain essential for the choice of energy sources and that the EU ETS constitutes a justified environmental policy.

4.4. Objection 4: finding agreement on a common price floor will be impossible, and unilateral carbon price floors would fragment EU climate policy

Objection: Reluctant member states will strongly oppose a price floor above current or expected prices, since that effectively increases the level of ambition of the ETS. If the price floor is set at a lower level than the current

price, it is irrelevant. If agreement on a common price floor cannot be achieved, a unilateral price floor implemented by one member state or a coalition of member states will reinforce political fragmentation, divergence and inefficiency in decarbonization pathways across Europe.

Response: For a few years, France was the only EU member state openly advancing the idea of a price floor (Szabo, 2016). Like the UK CPF, the French initiative envisioned a price floor only for the power sector.[3] More recently, supportive signals have also come from the Netherlands (ICAP, 2017), Sweden (Stam, 2018), and Portugal and Spain (Brnic & Thévoz, 2018). German discussions about the carbon price floor option have intensified (e.g. Demirdag, 2018; Edenhofer, Flachsland, & Schmid, 2019; Fernahl, Perez-Linkenheil, Huneke, & Küchle, 2017; Hecking, Kruse, & Obermüller, 2017; Matthes, 2018). Stakeholders likely to benefit from higher EUA prices (e.g. nuclear, gas and renewable power generators) can be expected to support this option.

Setting a price floor below the prevailing level of the carbon price should facilitate its adoption. The main goal of the price floor would be to provide insurance against the risk of price drops that threaten low-carbon investments. The price floor can automatically increase at a specified rate, such as the opportunity cost of capital plus inflation. For example, the California ETS price floor increases at 5% plus inflation, and the price trigger for RGGI's Emissions Containment Reserve will increase at 7%, annually independent of inflation after it is introduced in 2021 (ICAP, 2019).

A harmonized EU-wide approach would be clearly preferable to avoid political fragmentation. An EU-wide approach may not be initially politically feasible though, e.g. if distributional effects of a price floor (Brink, Vollebergh, & van der Werf, 2016; Pahle, Burtraw, Tietjen, et al., 2018) cannot be addressed via well-established bargaining channels such as the reallocation of allowances (Dorsch, Flachsland, & Kornek, 2019). There may be reasons for a coalition to nevertheless act as a first mover, initiating a policy sequence (Pahle, Burtraw, Flachsland, et al., 2018) that would eventually lead to the remaining EU states joining. This strategy would be in line with considerations of shifting toward a Europe where 'those who want more, do more' to overcome political impasse (European Commission, 2017).

5. Conclusion: the way forward

An EU ETS price floor to be adopted by *all* member states could be advanced in the context of various policy processes:

- **2021**: **MSR review**. The review could be used to initiate the process for formally assessing and proposing price floor legislation, with a subsequent legislative process to be finished around 2023. For example, an EU-wide auction reserve price could be considered that would adjust the MSR such that the trigger for removal of allowances from primary auctions would be an EUA primary auction reserve price in addition to, or potentially in place of, the quantity threshold level of 833 Mt allowances in circulation.
- **2023: Paris Agreement Global Stocktake.** This international effort under the Paris Agreement could be used to initiate a process for formally assessing and proposing price floor legislation within the EU ETS, with a subsequent legislative process to be finished around 2025.

In parallel to an EU-wide price floor, a bottom-up *coalition of a few* EU countries would have more flexibility in the timing of their action to implement a unilateral price floor. The Netherlands, for example, are currently implementing legislation to implement a unilateral floor price. An agreement between Germany and France would arguably be essential to advance such a coalition. Germany has decided on a broader reform of its carbon pricing approach, including a call for adopting a price floor in the EU ETS (Edenhofer, Flachsland, Kalkuhl, Knopf, & Pahle, 2019; German Government, 2019; Newbery et al., 2019). Over time, this coalition could grow and eventually create sufficient support for an EU-wide price floor.

To summarize, given the risk that EU ETS allowance prices might drop again due to unresolved fundamental challenges, adding a carbon floor price would go a long way towards enhancing policy credibility and thus incentivizing investments into low-carbon technologies. Implementing a floor price cooperatively at the EU level would not only make carbon pricing more dynamically efficient, but also advance and showcase the

feasibility of multilateral cooperation. Ultimately, developing and testing efficient and cooperative climate policies is probably the biggest contribution the EU can make to global climate policy.

Notes

1. As a short-term measure to reduce the allowances in circulation, the EU Commission withheld allowances from auctions from 2014 to 2016 (400 million allowances in 2014, 300 million in 2015, and 200 million in 2016). Initially, it was planned to auction these in 2019 and 2020. With adoption of the MSR, these allowances were directly transferred into the MSR.
2. We do not consider the case of a price ceiling that would trigger the release of additional allowances, which might lead to non-achievement of the original quantitative target.
3. Some note that because the French electricity mix is heavily based on nuclear power, it would benefit from an increasing carbon price (Hecking et al., 2017; Pahle, Burtraw, Tietjen, et al., 2018).

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References

Acworth, W., Ackva, J., Burtraw, D., Edenhofer, O., Fuss, S., Flachsland, C., … Montes de Oca, M. (2017). Emissions trading and the role of a long run carbon price signal: Achieving cost effective emission reductions under an Emissions Trading System. Berlin: ICAP.

Beck, U., & Kruse-Andersen, P. (2018). Endogenizing the cap in a cap-and-trade system: Assessing the agreement on EU ETS phase 4. De Oekonomiske Rad Working Paper 2018:2.

Bocklet, J., Hintermayer, M., Schmidt, L., & Wildgrube, T. (2019). The reformed EU ETS - intertemporal emission trading with restricted banking. EWI Working Paper, No 19/04.

Boehringer, C., & Fischer, C. (2018). Emissions floor price options for EU member states. University of Oldenburg and Vrije Universiteit Amsterdam.

Borenstein, S., Bushnell, J., Wolak, F., & Zaragoza-Watkins, M. (2018). Expecting the unexpected: Emissions uncertainty and environmental market design. Haas Working Paper.

Brink, C., Vollebergh, H., & van der Werf, E. (2016). Carbon pricing in the EU: Evaluation of different EU ETS reform options. *Energy Policy*, *97*, 603–617.

Brnic, A. H., & Thévoz, L. F. (2018, July 31). EDF hopes for European CO_2 price floor within months. *Montel*. Retrieved from https://www.montelnews.com/en/story/edf-hopes-for-european-co2-price-floor-within-months/922209

Bruninx, K., Ovaere, M., & Delarue, E. (2018). A first analysis of the market stability reserve in the European Emission trading system. TME Working Paper.

Burtraw, D., Holt, C., Palmer, K., Paul, A., & Shobe, W. (2018). Quantities with prices. Resources for the Future Working Paper 18–08.

Burtraw, D., Palmer, K., & Kahn, D. (2010). A symmetric safety valve. *Energy Policy*, *38*(9), 4921–4932.

Carlén, B., Dahlqvist, A., Mandell, S., & Marklund, P. (2019). EU ETS emissions under the cancellation mechanism - effects of national measures. *Energy Policy*, *129*, 816–825.

Danish Council on Climate Change. (2017). The inflated EU emissions trading system. Consequences of the EU ETS and Surplus of Allowances for Danish Climate Policy.

Demirdag, J. (2018, July 16). Eleven German state ministers urge CO_2 price floor. *Montel*. Retrieved from https://www.montelnews.com/en/story/eleven-german-state-ministers-urge-co2-price-floor-/918136

Dorsch, M., Flachsland, C., & Kornek, U. (2019). Building and enhancing climate policy ambition with transfers: Allowance allocation and revenue spending in the EU ETS. *Environmental Politics*, in print.

EC – European Commission. (2019). EU ETS revision for phase 4 (2021–2030). Retrieved from https://ec.europa.eu/clima/policies/ets/revision

Edenhofer, O., Flachsland, C., Kalkuhl, M., Knopf, B., & Pahle, M. (2019). Optionen für eine CO_2-Preisreform. MCC-PIK-Expertise for the German Council of Economic Experts.

Edenhofer, O., Flachsland, C., & Schmid, L. K. (2019). Decarbonization and EU ETS reform: Introducing a price floor to drive low-carbon investments. In M. Angrick, C. Kühleis, J. Landgrebe, & J. Weiß (Eds.), *12 years of European Emissions trading in Germany. Stocktaking and perspectives for effective climate protection* (pp. 207–232). Metropolis.

Ellerman, D., Marcantonini, C., & Zaklan, A. (2016). The European Union emissions trading system: Ten years and counting. *Review of Environmental Economics and Policy*, *10*(1), 89–107.

European Commission. (2017, March 1). *White paper on the future of Europe. Reflections and Scenarios for the EU27 by* 2025. European Commission COM (2017) 2025. Retrieved from https://ec.europa.eu/commission/sites/beta-political/files/white_paper_on_the_future_of_europe_en.pdf

Fernahl, A., Perez-Linkenheil, C., Huneke, F., & Küchle, I. (2017). *Wirkungsweise einer CO_2-Steuer im Stromsektor*. Berlin: Energy Brainpool.

Fischer, C., Reins, L., Burtraw, D., Langlet, D., Mehling, M., Weishaar, S., … Lofgren, A. (2018). The legal and economic case for an auction reserve price in the EU emissions trading system. Working paper, May 30.

Friedrich, M., Mauer, E. M., Pahle, M., & Tietjen, O. (2019). From fundamentals to financial assets: The evolution of understanding price formation in the EU ETS. Working paper.

Friedrich, M., & Pahle, M. (2019). Allowance prices in the EU ETS – fundamental price drivers and the recent upward trend. Working paper. Retrieved from https://arxiv.org/abs/1906.10572

Fuss, S., Flachsland, C., Koch, N., Kornek, U., Knopf, B., & Edenhofer, O. (2018). A framework for assessing the performance of cap-and-trade systems: Insights from the European Union emissions trading system. *Review of Environmental Economics and Policy*, *12*(2), 220–241.

German Government. (2019). Eckpunkte für das Klimaschutzprogramm 2030. Retrieved from https://www.bundesregierung.de/resource/blob/997532/1673502/768b67ba939c098c994b71c0b7d6e636/2019-09-20-klimaschutzprogramm-data.pdf?download=1

Hecking, H., Kruse, J., & Obermüller, F. (2017). Analysis of an EU-wide carbon price support: Impact on CO_2 emissions, cost efficiency and rents. EWI Energy Research & Scenarios. Retrieved from https://www.ewi.research-scenarios.de/cms/wp-content/uploads/2017/01/Analysis-of-an-Euwide-Carbon-Price-Support.pdf

Hepburn, C. (2006). Regulation by prices, quantities, or both: A review of instrument choice. *Oxford Review of Economic Policy*, *22*(2), 226–247.

Hintermann, B., Peterson, S., & Rickels, W. (2016). Price and market behavior in phase II of the EU ETS: A review of the literature. *Review of Environmental Economics and Policy*, *10*(1), 108–128.

Hirst, D. (2018, January 8). Carbon price floor (CPF) and the price support mechanism. House of Commons Library Briefing Paper No. 05927. Retrieved from http://researchbriefings.files.parliament.uk/documents/SN05927/SN05927.pdf

ICAP (International Carbon Action Partnership). (2017). Netherlands proposes EUR 18 carbon price floor. Retrieved from https://icapcarbonaction.com/fr/news-archive/491-netherlands-proposes-eur-18-carbon-price-floor

ICAP (International Carbon Action Partnership). (2019). ETS Map.

Knopf, B., Koch, N., Grosjean, G., Fuss, S., Flachsland, C., Pahle, M., … Edenhofer, O. (2014). The European Emissions Trading System (EU ETS): ex-post analysis, the market stability reserve and options for a comprehensive reform. FEEM Nota di Lavoro Working Paper.

Koch, N., Fuss, S., Grosjean, G., & Edenhofer, O. (2014). Causes of the EU ETS price drop: Recession, CDM, renewable policies or a bit of everything?—New evidence. *Energy Policy*, *73*, 676–685.

Koch, N., Grosjean, G., Fuss, S., & Edenhofer, O. (2016). Politics matters: Regulatory events as catalysts for price formation under cap-and-trade. *Journal of Environmental Economics and Management*, *78*, 121–139.

Kollenberg, S., & Taschini, L. (2019). Dynamic supply adjustment and banking under uncertainty in an emission trading scheme: The market stability reserve. *European Economic Review*, *118*, 213–226.

Löfgren, Å, Burtraw, D., Wråke, M., & Malinovskaya, A. (2018). Distribution of emissions allowances and the use of auction revenues in the European Union emissions trading system. *Review of Environmental Economics and Policy*, *12*(2), 284–303.

Matthes, F. (2018). Dem Ziel verpflichtet. CO_2-Mindestpreise im Instrumentenmix einer Kohle-Ausstiegsstrategie für Deutschland. Retrieved from https://www.oeko.de/aktuelles/2018/mindestpreis-auf-co2-fuer-mehr-klimaschutz/

Mauer, E. M., Okullo, S., & Pahle, M. (2019). Evaluating the performance of the EU ETS MSR. Paper presented at the 2019 Mannheim Energy Conference.

Newbery, D. M., Reiner, D. M., & Ritz, R. A. (2019). The political economy of a carbon price floor for power generation. *The Energy Journal*, *40*, 1–24.

Newell, R. G., & Pizer, W. A. (2003). Regulating stock externalities under uncertainty. *Journal of Environmental Economics and Management*, *45*(2), 416–432.

Osorio, S., Pietzcker, R., Pahle, M., & Edenhofer, O. (2018). How to deal with the risks of phasing out coal in Germany through national carbon pricing. CESifo Working Paper No. 7438.

Pahle, M., Burtraw, D., Flachsland, C., Kelsey, N., Biber, E., Meckling, J., … Zysman, J. (2018). Sequencing to ratchet up climate policy stringency. *Nature Climate Change*, *8*, 861–867.
Pahle, M., Burtraw, D., Tietjen, O., Flachsland, C., & Edenhofer, O. (2018). Preserving the integrity of the EU ETS under unilateral action. Paper presented at World Congress for Environmental and Resource Economics, Gothenburg.
Pahle, M., Edenhofer, O., Pietzcker, R., Tietjen, O., Osorio, S., & Flachsland, C. (2019). Die unterschätzten Risiken des Fahrplans für den Kohleausstieg. *Energiewirtschaftliche Tagesfragen*, *69*(6), 31–34.
Perino, G. (2018). New EU ETS phase 4 rules temporarily puncture waterbed. *Nature Climate Change*, *8*, 262–264.
Perino, G., Ritz, R. A., & van Benthem, A. (2019). Understanding overlapping policies: Internal carbon leakage and the punctured waterbed. NBER Working Paper No. 25643.
Perino, G., & Willner, M. (2016). Procrastinating reform: The impact of the market stability reserve on the EU ETS. *Journal of Environmental Economics and Management*, *80*, 37–52.
Perino, G., & Willner, M. (2017). EU-ETS phase IV: Allowance prices, design choices and the market stability reserve. *Climate Policy*, *17*(7), 936–946.
Quemin, S., & Trotignon, R. (2019). Emissions trading with rolling horizons. Working Paper.
Roberts, M. J., & Spence, M. (1976). Effluent charges and licenses under uncertainty. *Journal of Public Economics*, *5*(3–4), 193–208.
Rosendahl, K. E. (2019). EU ETS and the new green paradox. Working Paper Series 2-2019, Norwegian University of Life Sciences, School of Economics and Business.
Salant, S. W. (2016). What ails the European Union's emissions trading system? *Journal of Environmental Economics and Management*, *80*, 6–19.
Sandbag. (2017). An agenda for strategic reform of the ETS. What's the future for EU carbon pricing? Report.
Sheppard, D. (2018, September 6). Hedge funds and Wall St banks cash in on carbon market's revival. *Financial Times*.
Silbye, F., & Sørensen, P. B. (2018). Towards a more efficient European carbon market. Working Paper.
Stam, C. (2018, April 18). Ministers highlight European divide over carbon price floor. *Euractiv*. Retrieved from https://www.euractiv.com/section/emissions-trading-scheme/news/ministers-highlight-european-divide-over-carbon-price-floor/
Szabo, M. (2016, March 13). 'We can't wait any longer': France floats EU ETS price support proposal. *Carbon Pulse*. Retrieved from http://carbon-pulse.com/16939/
Tagesspiegel. (2018, September 12). CO_2-Preis sprengt alle Prognosen. Tagesspiegel background.
Tietjen, O., Lessmann, K., & Pahle, M. (2019). Hedging and the temporal permit issuance in cap-and-trade programs: The market stability reserve under risk aversion. Retrieved from https://ssrn.com/abstract=3436736
Weitzman, M. L. (1974). Prices vs. quantities. *Review of Economic Studies*, *41*(4), 477–491.
Wood, P. J., & Jotzo, F. (2011). Price floors for emissions trading. *Energy Policy*, *39*, 1746–1753.